WHAT IS CLAIMED IS:

1. An optical processing method comprising:

receiving an optical signal from an optical system, wherein the optical signal is distorted by frequency-dependent polarization effects in the optical system;

spatially dispersing frequency components of the distorted optical signal on a spatial light modulator (SLM); and

independently adjusting the polarization transfer matrix of multiple regions of the SLM to reduce the distortion of the optical signal.

2. The method of claim 1, wherein the frequency dependent polarization effects cause wavelength dependent changes in the state of polarization (SOP) of the optical signal.

3. The method of claim 1, wherein the frequency-dependent polarization effects include polarization mode dispersion effects.

4. The method of claim 3, wherein the polarization mode dispersion effects can be represented by a frequency-dependent polarization transfer matrix characterized by a frequency-dependent differential delay and principal states of polarization.

5. The method of claim 1, wherein the optical signal comprises multiple signals on separate wavelength bands.

6. The method of claim 1, wherein the optical system includes at least one optical fiber.

7. The method of claim 1, further comprising recombining the spatially dispersed frequency components following the adjustments by the spatial light modulator.

8. The method of claim 1, further comprising monitoring the frequency-dependent polarization effects from the optical system.

9. The method of claim 8, wherein the adjustments by the spatial light modulator are in response to the monitoring of the frequency-dependent polarization effects.

10. The method of claim 1, wherein the spatial dispersion of the frequency components comprises using a grating, a prism, an arrayed waveguide grating, or a virtually imaged phase array.

11. The method of claim 1, wherein the spatial light modulator comprises at least one liquid crystal layer.

12. The method of claim 11, wherein the spatial light modulator comprises at least two liquid crystal (LC) layers, wherein the LC molecules in each of the LC layers are oriented along an axis, and wherein the axis for one of the LC layers is different from the axis of another of the LC layers.

13. The method of claim 12, wherein the axes differ from one another by an absolute amount of about 45 degrees.

14. The method of claim 13, wherein the absolute amount is in the range of 42 degrees to 48 degrees.

15. The method of claim 12, wherein the spatial light modulator comprises at least three layers.

16. The method of claim 15, wherein the orientation axis of a first of the LC layers differs from the orientation axis of a second of the LC layer by absolute amount of about 45 degrees, and wherein the orientation of the second of the LC layers differs from the orientation axis of a third of the LC layers by an absolute amount of about 45 degrees.

17. The method of claim 1, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase, state of polarization (SOP), and amplitude of each of multiple subsets of the spatially dispersed frequency components.

18. The method of claim 1, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

19. The method of claim 1, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

20. The method of claim 1, wherein the adjustments to the polarization transfer matrix are selected to cause independent adjustments to the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

21. The method of claim 20, wherein the frequency-dependent polarization effects include polarization mode dispersion (PMD), and the adjustments caused by the SLM at least partially compensate for the PMD.

22. The method of claim 1, wherein the distortions comprise broadening of mean pulse duration in the optical signal, and wherein the adjustments reduce the broadening caused by the optical system.

23. The method of claim 1, wherein the adjustments are selected to cause the state of polarization (SOP) of at least some of the frequency components to be substantially the same.

24. The method of claim 23, wherein the adjustments are selected to cause the delay of the at least some of the frequency components to be substantially the same.

25. An optical processing method comprising:

providing a precompensation signal indicative of frequency-dependent polarization effects in a downstream optical system;

spatially dispersing frequency components of an optical signal on a spatial light modulator (SLM); and

independently adjusting the polarization transfer matrix of multiple regions of the SLM to at least partially precompensate the optical signal for distortions caused by the frequency-dependent polarization effects in the downstream optical system.

26. The method of claim 25, wherein the frequency dependent polarization effects cause wavelength dependent changes in the state of polarization (SOP) of the optical signal.

27. The method of claim 25, wherein the frequency-dependent polarization effects include polarization mode dispersion (PMD) effects.

28. The method of claim 27, wherein the polarization mode dispersion effects can be represented by a frequency-dependent polarization transfer matrix characterized by a frequency-dependent differential delay and principle states of polarization.

29. The method of claim 27, wherein the PMD effects define wavelength-dependent principle states of polarization (PSP) in the downstream optical system, and wherein the adjustments are selected to align the state of polarization of at least some of the spatially dispersed frequency components with the wavelength-dependent PSP in the downstream optical system.

30. The method of claim 25, wherein the optical signal comprises multiple signals on separate wavelength bands.

31. The method of claim 25, wherein the downstream optical system includes at least one optical fiber.

32. The method of claim 25, further comprising recombining the spatially dispersed frequency components following the adjustments by the spatial light modulator.

33. The method of claim 25, wherein the spatial dispersion of the frequency components comprises using a grating, a prism, an arrayed waveguide grating, or a virtually imaged phase array.

34. The method of claim 25, wherein the spatial light modulator comprises at least one liquid crystal layer.

35. The method of claim 34, wherein the spatial light modulator comprises at least two liquid crystal (LC) layers, wherein the LC molecules in each of the LC layers are oriented along an axis, and wherein the axis for one of the LC layers is different from the axis of another of the LC layers.

36. The method of claim 35, wherein the axes differ from one another by an absolute amount of about 45 degrees.

37. The method of claim 36, wherein the absolute amount is in the range of 42 degrees to 48 degrees.

38. The method of claim 35, wherein the spatial light modulator comprises at least three layers.

39. The method of claim 38, wherein the orientation axis of a first of the LC layers differs from the orientation axis of a second of the LC layer by absolute amount of about 45 degrees, and wherein the orientation of the second of the LC layers differs from the orientation axis of a third of the LC layers by an absolute amount of about 45 degrees.

40. The method of claim 25, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase, state of polarization (SOP), and amplitude of each of multiple subsets of the spatially dispersed frequency components.

41. The method of claim 25, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

42. The method of claim 25, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

43. The method of claim 25, wherein the adjustments to the polarization transfer matrix are selected to cause independent adjustments to the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

44. The method of claim 43, wherein the frequency-dependent polarization effects include polarization mode dispersion (PMD), and the adjustments caused by the SLM at least partially precompensate for the PMD.

45. The method of claim 25, wherein the distortions comprise broadening of mean pulse duration in the optical signal, and wherein the adjustments reduce the broadening caused by the downstream optical system.

46. The method of claim 25, wherein the adjustments are selected to cause the state of polarization (SOP) of at least some of the frequency components to be substantially the same following transmission through the downstream optical system.

47. The method of claim 46, wherein the adjustments are selected to cause the delay of the at least some of the frequency components to be substantially the same following transmission through the downstream optical system.

48. The method of claim 25, wherein the frequency-dependent polarization effects include frequency-dependent polarization dependent loss (PDL), and wherein the adjustments are selected to align the state of polarization (SOP) of at least some of the spatially dispersed frequency components with the frequency-dependent axis that minimizes loss from the frequency-dependent PDL.

49. The method of claim 1, further comprising using the SLM to selectively vary the intensity of at least some of the spatially dispersed frequency components.

50. The method of claim 25, further comprising using the SLM to selectively vary the intensity of at least some of the spatially dispersed frequency components.

51. A method for emulating transmission of an optical signal through an optical system having frequency-dependent polarization effects, the method comprising:

providing a model of the frequency-dependent polarization effects;

spatially dispersing frequency components of the optical signal on a spatial light modulator (SLM); and

independently adjusting the polarization transfer matrix of multiple regions of the SLM based on the model to emulate the optical signal transmission.

52. The method of claim 51, wherein the frequency dependent polarization effects cause wavelength dependent changes in the state of polarization (SOP) of the optical signal.

53. The method of claim 51, wherein the frequency-dependent polarization effects include polarization mode dispersion (PMD) effects.

54. The method of claim 51, wherein the polarization mode dispersion effects can be represented by a frequency-dependent polarization transfer matrix characterized by a frequency-dependent differential delay and principle states of polarization.

55. The method of claim 53, wherein the model of the PMD effects has statistics that differ from those of an optical fiber having PMD.

56. The method of claim 53, wherein the model of the PMD effects has statistics that are similar to those of an optical fiber having PMD.

57. The method of claim 51, wherein the optical signal comprises multiple signals on separate wavelength bands.

58. The method of claim 51, further comprising recombining the spatially dispersed frequency components following the adjustments by the spatial light modulator.

59. The method of claim 51, wherein the spatial dispersion of the frequency components comprises using a grating, a prism, an arrayed waveguide grating, or a virtually imaged phase array.

60. The method of claim 51, wherein the spatial light modulator comprises at least one liquid crystal layer.

61. The method of claim 60, wherein the spatial light modulator comprises at least two liquid crystal (LC) layers, wherein the LC molecules in each of the LC layers are oriented along an axis, and wherein the axis for one of the LC layers is different from the axis of another of the LC layers.

62. The method of claim 61, wherein the axes differ from one another by an absolute amount of about 45 degrees.

63. The method of claim 62, wherein the absolute amount is in the range of 42 degrees to 48 degrees.

64. The method of claim 61, wherein the spatial light modulator comprises at least three layers.

65. The method of claim 64, wherein the orientation axis of a first of the LC layers differs from the orientation axis of a second of the LC layers by absolute amount of about 45 degrees, and wherein the orientation of the second of the LC layers differs from the orientation axis of a third of the LC layers by an absolute amount of about 45 degrees.

66. The method of claim 51, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase, state of polarization (SOP), and amplitude of each of multiple subsets of the spatially dispersed frequency components.

67. The method of claim 51, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to at least one of the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

68. The method of claim 51, wherein the adjustments to the polarization transfer matrix are selected to cause an adjustment to the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

69. The method of claim 51, wherein the adjustments to the polarization transfer matrix are selected to cause independent adjustments to the phase and the state of polarization (SOP) of each of multiple subsets of the spatially dispersed frequency components.

70. The method of claim 1, wherein the adjustments are selected to independently delay a selected polarization component of each of multiple subsets of the spatially dispersed frequency components.

71. The method of claim 25, wherein the adjustments are selected to independently delay a selected polarization component of each of multiple subsets of the spatially dispersed frequency components.

72. The method of claim 51, wherein the adjustments are selected to independently delay a selected polarization component of each of multiple subsets of the spatially dispersed frequency components.

73. The method of claim 23, wherein the adjustments are selected to cause the phase of the at least some of the frequency components to be substantially the same.

74. The method of claim 23, wherein the adjustments are selected to cause the phase of the at least some of the frequency components to vary substantially linearly with frequency,

75. The method of claim 46, wherein the adjustments are selected to cause the phase of the at least some of the frequency components to be substantially the same following transmission through the downstream optical system.

76. The method of claim 46, wherein the adjustments are selected to cause the phase of the at least some of the frequency components to vary substantially linearly with frequency following transmission through the downstream optical system.

77. An optical processing system for reducing a distortion in an optical signal transmitted through an optical system having frequency-dependent polarization effects, the optical processing system comprising:

a dispersive module positioned to receive the optical signal and spatially separate frequency components of the optical signal;

a spatial light modulator (SLM) having multiple regions with an independently adjustable polarization transfer matrix, the SLM positioned to receive the spatially separated frequency components on the multiple regions; and

a controller coupled to the SLM, wherein during operation the controller causes the SLM to independently adjust the polarization transfer matrix of the multiple regions to reduce the distortion of the optical signal.

78. An optical processing system for at least partially precompensating an optical signal for frequency-dependent polarization effects in a downstream optical system, the optical processing system comprising:

a dispersive module positioned to receive the optical signal and spatially separate frequency components of the optical signal;

a spatial light modulator (SLM) having multiple regions with an independently adjustable polarization transfer matrix, the SLM positioned to receive the spatially separated frequency components on the multiple regions; and

a controller coupled to the SLM and configured to receive a precompensation signal indicative of the frequency-dependent polarization effects in the downstream optical system, wherein during operation the controller responds to the precompensation signal by causing the SLM to independently adjust the polarization transfer matrix of the multiple regions to at least partially precompensate the optical signal for distortions caused by the frequency-dependent polarization effects.

79. An optical emulator system for emulating transmission of an optical signal through an optical system having frequency-dependent polarization effects, the emulator comprising:

a dispersive module positioned to receive the optical signal and spatially separate frequency components of the optical signal;

a spatial light modulator (SLM) having multiple regions with an independently adjustable polarization transfer matrix, the SLM positioned to receive the spatially separated frequency components on the multiple regions; and

a controller coupled to the SLM, wherein during operation the controller causes the SLM to independently adjust the polarization transfer matrix of the multiple regions to emulate the optical signal transmission based on a model of the frequency-dependent polarization effects.